UNIVERSITY OF THE PUNJAB

B.S. in Computer Science Third Year : Annual–2021

Roll No. .....

Subject: Operating Systems | Paper: 12 | Time: 2 Hrs. 30 Min. Marks: 80

ATTEMPT THIS (SUBJECTIVE) ON THE SEPARATE ANSWER SHEET PROVIDED

NOTE: Attempt any FOUR questions. All questions carry equal marks.

Question # 2

Give short answers to the following questions: **(4 each)**

a) Briefly explain the characteristics and working principle of time-sharing systems.
b) What is a virtual machine and what are its advantages?
c) What is a system call and how it works?
d) Briefly explain critical section and critical section problem of co-operating processes.
e) What is a thread? How the thread creation is different from spawning a new process?

Question # 3

a) Define process and explain the process creation mechanism. Also discuss different states of a process. (10)
b) Discuss the methods, mechanism, and tools of inter-process communication. (10)

Question # 4

Consider the following set of processes, with the length of the CPU burst given in milliseconds: (20)

Process	Arrival Time	Burst Time	Priority#
P1	0	8	3
P2	1	6	2
P3	2	7	1
P4	3	5	2
P5	4	4	3

Draw the Gantt charts illustrating the execution of the above processes using the following scheduling algorithms. Also compute Average Waiting Time (AWT) of the algorithms.

i) Preemptive priority scheduling (a smaller number implies higher priority)
ii) Round Robin scheduling (quantum=3)

Question # 5

a) What is a semaphore? What can be achieved by initializing a semaphore with 0, 1 or n? What problems may occur due to wrong initialization or placement of wait and signal operations. (10)

P.T.O.

b) Consider the snapshot of a system. A = 14, B = 16, C = 12, D= 10 (10)

Process	Max A B C D	Allocation A B C D	Need A B C D	Available A B C D
P0	8 4 6 2	2 4 2 0		
P1	4 6 8 4	4 2 2 0		
P2	6 4 2 4	4 2 0 2		
P3	4 8 6 4	0 4 4 2		
P4	4 6 4 2	2 0 2 0		

Answer the following questions using Banker's Agorithm:

i) What is the content of the matrix need?
ii) Is the system in a safe state? If yes, then what is the safe sequence? Show your work.
iii) Determine whether the following sequences are safe or not?
P2, P3, P4, P0, P1; P3, P4, P0, P2, P4; P2, P4, P0, P3, P1;

Question # 6

a) What is a page table and what are the advantages of paged memory system? Briefly explain the structure of hierarchical and inverted page table. (10)
b) Consider a logical address of 36 bits with 256 segments per process and a page size of 4KB. The available RAM is of 4GB. Find the number of pages per segment, maximum process size, maximum segment size, format of logical address and format of physical address. (5)
c) Consider a system with 48-bit logical address space that supports 8KB page size. Available physical memory is 64GB. Operating system running on this system used inverted page table and supports 32-bit process IDs. Calculate the number of bits required for p, d and f. Also calculate the PTES and page table size. (5)

UNIVERSITY OF THE PUNJAB

B.S. in Computer Science Third Year : Annual–2021

Subject: Operating Systems

Paper: 12

Time: 30 Min. Marks: 20

Roll No. in Fig. .....

Roll No. in Words. .....

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Signature of Supdt.:

Attempt this Paper on this Question Sheet only.
Division of marks is given in front of each question.
This Paper will be collected back after expiry of time limit mentioned above.

Q.1. Encircle the right answer cutting and overwriting is not allowed. (20x1=20)

1. Switching the CPU to another Process requires to save state of the old process and loading new process state is called _____.

   A. Context Switch B. Process import C. Process export D. Process switch

2. In operating system, each process has its own _____.

   A. Address space B. Open files C. State D. All of the mentioned

3. The state of process after it is submitted in the main memory is _____ state.

   A. Running B. Ready C. Blocked D. Excitation

4. _____ ensures that no process exceeds the time quota allocated to it.

   A. CPU protection C. Time management
   B. Process management D. Quota protection

5. Which of the following scheduler is invoked when a process is swapped out of main memory?

   A. Long term scheduler C. Medium term scheduler
   B. Short term scheduler D. All of the given

6. If all processes are CPU bound, the ready queue will almost always be _____, and the short-term scheduler will have a _____ to do.

   A. full, little B. full, lot C. empty, little D. empty, lot

7. Threads within a process share _____ with other threads of the same process

   A. Open files B. State C. Stack D. Registers

8. Which of the following is the disadvantage of using Threads?

   A. Economy B. Performance C. Robustness D. Responsiveness

9. Which one of the following is an inter-process communication tool for the processes residing at different machines?

   A. FIFO B. Pipe C. Socket D. Signal

10. A solution to the problem of indefinite blockage of low – priority processes is called _____.

    A. Starvation B. Wait queue C. Ready queue D. Aging

11. _____system call overrides the code of child process.

A. fork B. exec C. wait D. signal

12. Which of the following may not be the reason of failure of the fork() system call?

A. Maximum number of processes allowed on the system has exceeded
B. Maximum number of processes allowed under one user has exceeded
C. Not enough swap space
D. The PPFDT of parent process is full

13. Which of the following is not a condition to solve the critical section problem?

A. Progress B. Mutual Exclusion C. Bounded Waiting D. No Preemption

14. If semaphore is being used for mutual exclusion problem, then it must be initialized by _____.

A. One B. Zero C. Any positive integer D. None of the given

15. An un-interruptible operation is known as _____.

A. Single B. atomic C. static D. micro

16. Which one of the following is the deadlock avoidance algorithm?

A. banker's algorithm C. round-robin algorithm
B. elevator algorithm D. karn's algorithm

17. In fixed sized partition, the degree of multi programming is bounded by the _____

A. CPU C. Number of partitions
B. Memory size D. Partition size

18. The mechanism that brings a page into memory only when it is needed is called _____.

A. Segmentation C. Page Replacement
B. Fragmentation D. Demand Paging

19. A computer system has 48-bit logical address, page size of 4KB, and page table entry size of two bytes. What will be the page table size?

A. 2^{32} Bytes B. 2^{37} Bytes C. 2^{40} Bytes D. 2^{48} Bytes

20. A computer system has 36-bit logical address with a page size of 4KB. The maximum number of pages a process can have is _____.

A. 2^{12} B. 2^{16} C. 2^{24} D. 2^{36}

UNIVERSITY OF THE PUNJAB

B.S. in Computer Science Third Year : Annual–2021

Roll No. .....

Subject: Software Engineering Paper: 13 Time: 3 Hrs. Marks: 100

NOTE: Attempt any FIVE out of seven questions. Question # 1 is compulsory to attempt. Each question carries 20 marks.

Question 1: (20 marks)

WRITE BRIEF NOTES ON THE FOLLOWING:

A. BLACK BOX TESTING

B. COHESION & COUPLING

C. RISK MANAGEMENT

D. SOFTWARE QUALITY STANDARDS

Question 2: (20 marks)

List down stages of Software Development Life Cycle (SDLC)? Also write a brief explanation on SDLC stage DESIGN? Support your answer with example?

Question 3: (20 marks)

Define and list 4-Ps in project management? Also write a short explanation of PEOPLE in 4-Ps?

Question 4: (20 marks)

Write a brief note on "WATERFALL PROCESS MODELS"? Also explain merits and demerits of the model with reference to Project Requirements?

Question 5: (20 marks)

Write a brief note on USE CASE Diagram? What are different USE CASE RELATIONSHIPS? Give suitable examples to support your answer?

Question 6: (20 marks)

What is Level-0 DATA FLOW Diagram? How is different from Level-1 and Level-2 Data Flow Diagrams? Explain your answer with suitable examples?

Question 7: (20 marks)

In PROJECT MANAGEMENT what is the importance of SOFTWARE COSTING? Discuss size based Software Costing LOC (Lines of Code)?

UNIVERSITY OF THE PUNJAB

B.S. in Computer Science Third Year : Annual–2021

Roll No. .....

Subject: Database Systems Paper: 14 Time: 2 Hrs. 30 Min. Marks: 65

ATTEMPT THIS (SUBJECTIVE) ON THE SEPARATE ANSWER SHEET PROVIDED

NOTE: Attempt ALL questions.

[3+5+6=14 marks] Question 2:

(a) [3 marks] Outline the differences between BCNF and 4NF.

(b) [5 marks] Consider the relation Student(StudentId, Name, Birthyear, Age, Major, Dept) in which StudentId is the primary key.

Student has the following functional dependencies:

StudentId → Name, Birthyear, Major
Major → Dept
Birthyear → Age

Transform it to 2nd and 3rd normal form. Mention clearly if it is already in 2nd or 3rd normal form.

(c) [3x2=6 marks] Consider the follow attributes and functional dependencies:

A B C D E F H
A → D
AE → H
DF → BC

E → C
H → E

1. List all keys (not superkeys)

2. Consider the decomposition into 4 relations: (AEH) (ABEC) (AD) (CE). Is this decomposition in (circle all that apply):

a. BCNF
b. 3NF
c. 1NF
d. None of the above

3. Consider the decomposition into 3 relations: (AD) (EC) (ABEFH). Is this decomposition in (circle all that apply):

a. BCNF
b. 3NF
c. 1NF
d. None of the above

[6+20=26 marks] Question 3:

(a) **[6 marks]** What are the three major steps of the database design (data modeling) process?

(b) **[20 points]** You are designing a database for KW Humane Society. The result is the following set of relations where the type of each relations attribute is given following the attribute (e.g., ID: integer):

Animals(ID: integer, Name: string, PrevOwner: string, DateAdmitted: date, Type: string)
Adopter(SIN: integer, Name: string, Address: string, OtherAnimals: integer)
Adoption(AnimalID: integer, SIN: integer, AdoptDate: date, chipNo: integer)

where
(a) The primary keys are underlined.
(b) Animals stores information about the animals currently at the Humane Society. Each is given an ID, and their names together with the SIN of their previous owners (attribute PrevOwner), and their date of admission is recorded. Type refers to the type of animal (dog, cat, etc).
(c) Adopter is the relation that holds information about animal adopters. The attributes are self-descriptive, except OtherAnimals which records the number of other animals that the adopter currently has at home.
(d) AnimalID in Adoption refers to the ID of Animals. Similarly, SIN in Adoption refers to the SIN of Adopter. Attribute chipNo stores the number on the microchip that is implanted on the animal for tracking. Owner in Animals refers to the SIN of Adopter (in this case the previous adopter).

Formulate the following queries in SQL. *[5x4=20]*
(a) Retrieve the total number of dogs that were brought to the Humane Society on 18 April 2000.
(b) List the name of the adopter who has adopted every type of animal.
(c) For each animal type, list the animal type and total number of adoptions on 14 June 1999.
(d) List the types of animals who have not had any adoptions.
(e) For each adopter who has made at least two adoptions, list their names and addresses

[10 marks] Question 4:

A university registrar's office maintains data about the following entities: (a) courses, including number, title, credits, syllabus, and prerequisites; (b) course offerings, including course number, year, semester, section number, instructor(s), timings, and classroom; (c) students, including student-id, name, and program; and (d) instructors, including identification number, name, department, and title. Further, the enrollment of students in courses and grades awarded to students in each course they are enrolled for must be appropriately modeled. Construct an E-R diagram for the registrar's office.

[15 marks] Question 5:

Consider the relation Treatment with the schema **Treatment (doctorID, doctorName, patientID, diagnosis)** and functional dependencies;

$$\text{doctorID} \rightarrow \text{doctorName and}$$

$$(\text{doctorID, patientID}) \rightarrow \text{diagnosis.}$$

Describe different types of anomaly that can arise for this table with example records.

UNIVERSITY OF THE PUNJAB

B.S. in Computer Science Third Year : Annual–2021

Subject: Database Systems

Paper: 14 **Time: 30 Min. Marks: 10**

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Signature of Supdt.:

Attempt this Paper on this Question Sheet only.
Division of marks is given in front of each question.
This Paper will be collected back after expiry of time limit mentioned above.

Q.1. Encircle the right answer cutting and overwriting is not allowed. (10x1=10)

1. Which one of the following is a set of one or more attributes taken collectively to uniquely identify a record?
   a) Candidate key
   b) Sub key
   c) Super key
   d) Foreign key
2. The____condition allows a general predicate over the relations being joined.
   a) On
   b) Using
   c) Set
   d) Where
3. SQL view is said to be updatable (that is, inserts, updates or deletes can be applied on the view) if which of the following conditions are satisfied by the query defining the view?
   a) The from clause has only one database relation
   b) The query does not have a group by or having clause
   c) The select clause contains only attribute names of the relation and does not have any expressions, aggregates, or distinct specification
   d) All of the mentioned
4. The descriptive property possessed by each entity set is _____
   a) Entity
   b) Attribute
   c) Relation
   d) Model
5. The attribute *name* could be structured as an attribute consisting of first name, middle initial, and last name. This type of attribute is called
   a) Simple attribute
   b) Composite attribute
   c) Multivalued attribute
   d) Derived attribute
6. The attribute AGE is calculated from DATE_OF_BIRTH. The attribute AGE is
   a) Single valued
   b) Multi valued
   c) Composite
   d) Derived
7. Which-one ofthe following statements about normal forms is FALSE?
   a) BCNF is stricter than 3 NF
   b) Lossless, dependency -preserving decomposition into 3 NF is always possible
   c) Loss less, dependency – preserving decomposition into BCNF is always possible
   d) Any relation with two attributes is BCNF
8. The normal form which satisfies multivalued dependencies and which is in BCNF is
   a) 4 NF
   b) 3 NF
   c) 2 NF
   d) All of the mentioned
9. Which of the normal form is based on multivalued dependencies?
   a) First
   b) Second
   c) Third
   d) Fourth
10. A_____ is a query that retrieves rows from more than one table or view:
    a) Start
    b) End
    c) Join
    d) All of the mentioned

UNIVERSITY OF THE PUNJAB

B.S. in Computer Science Third Year : Annual–2021

Roll No. .....

Subject: Analysis of Algorithms Paper: 15 Time: 2 Hrs. 30 Min. Marks: 80

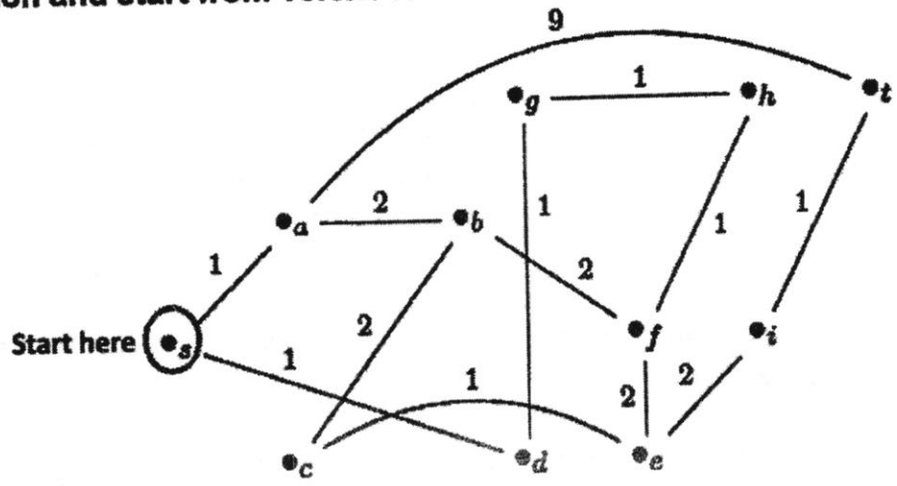
ATTEMPT THIS (SUBJECTIVE) ON THE SEPARATE ANSWER SHEET PROVIDED

Q.2 Suppose that you have a list of 1,000,000 grades (from 0% to 100%) on a nationwide test, and you want to put them in order (sort in any order). Design an algorithm that sorts this list in linear time (O(n)). Also, justify your choice of algorithm. **[10+4]**

Q.3 Fill in the following table with appropriate inputs, outputs and running times for each of the following algorithms. **[8*2=16]**

Algorithm	Input	Output	Time Complexity
DFS			
BFS			
Kruskal			
Prim's			
Dijkstra			
Floyd Warshall			
Knapsack Fractional			
Matrix Chain Multiplication			

Q.4 Draw the tree produced by running Prim's MST algorithm. Ignore edge orientation and start from vertex *s*. **[20]**



Q.5 Given below is a knapsack with maximum capacity W=11 and a set S consisting of 5 items with profits. How can we pack the knapsack to achieve maximal total value of packed items, when an item may either be Completely or Partially Selected? **[15]**

Item i	Weight w_i	Profit p_i
1	1	1
2	2	6
3	5	18
4	6	22
5	7	28

Q.6 The best-case running time for quick sort is O(*nlogn*) whereas the worst-case running time is O(n^2). Give recurrence relations of quick sort for both cases and discuss what types of input arrays result in best and worst case running times when quick sort is run on them, . **[10+5]**

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Signature of Supdt.:

B.S. in Computer Science Third Year : Annual–2021

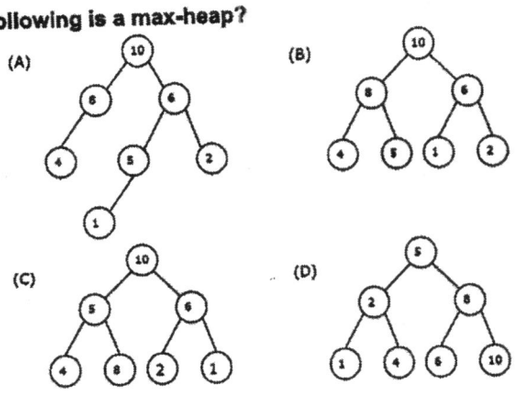
Subject: Analysis of Algorithms
Paper: 15

Time: 30 Min. Marks: 20

Attempt this Paper on this Question Sheet only.
Division of marks is given in front of each question.
This Paper will be collected back after expiry of time limit mentioned above.

Q.1. Encircle the right answer cutting and overwriting is not allowed. (10x2=20)

1. **What is the worst case time complexity of Djikstra's algorithm given V represents number of vertices and E represents number of edges in a graph?**
   i. O(VE)
   ii. O(VLog E)
   iii. $O(V^2)$
   iv. O(V)
2. **Which of the following sorting algorithms in its typical implementation gives best performance when applied on an array which is sorted or almost sorted (maximum 1 or two elements are misplaced)?**
   i. Quick sort
   ii. Heap sort
   iii. Merge sort
   iv. Insertion sort
3. **Which of the following is not O(n)?**
   i. $n^{0.98}$
   ii. 15^{10}Log n + 1099
   iii. n^2/ sqrt(n)
   iv. 40Log n
4. **Which of the following are property(s) of a dynamic programming problem?**
   i. Overlapping Sub-problems
   ii. Optimal Substructure
   iii. Memoization
   iv. Both I and II
5. **Which of the following is not a stable sorting algorithm in its typical implementation?**
   i. Quick sort
   ii. Bubble sort
   iii. Merge sort
   iv. Insertion sort
6. **What is the time complexity of Build Heap operation? Build Heap is used to build a max (or min) binary heap from a given array.**
   i. O(NLog N)
   ii. O(N)
   iii. O(N2)
   iv. O(Log N)
7. **Which of the following is a max-heap?**



   i. A
   ii. B
   iii. C
   iv. D
8. **Given an undirected graph G with V vertices and E edges, the sum of the degrees of all vertices is**
   i. E
   ii. V
   iii. 2E
   iv. 2V
9. **What is the objective of the knapsack problem??**
   i. To Get Maximum Total Value In The Knapsack
   ii. To Get Minimum Total Value In The Knapsack
   iii. To Get Maximum Weight In The Knapsack
   iv. To Get Minimum Weight In The Knapsack
10. **The Big Theta notation (Θ) of $f(n)=2n^3 + n - 1$ is _____?**
    i. n^3
    ii. n^2
    iii. n^4
    iv. n

UNIVERSITY OF THE PUNJAB

B.S. in Computer Science Third Year : Annual–2021

Roll No. .....

Subject: Numerical Analysis Paper: 16 Time: 3 Hrs. Marks: 100

NOTE: Attempt any FIVE in all while Question # 1 is compulsory.
All questions carry equal marks.

Question No. 1:

i) Approximate a root correct to four decimal places of the equation $\sin x = 5x - 2$ using a numerical method.

ii) Prove that $\mu^2 = 1 + \frac{\delta^2}{4}$, $1 + \mu^2\delta^2 = \left(1 + \frac{\delta^2}{2}\right)^2$

iii) Find the largest interval in which p^* must lie to approximate $p = \sqrt{2}$ with relative error at most 10^{-4}

iv) What do you mean by forward difference and backward difference?

v) Describe the difference between well-conditioned and ill-conditioned systems?

Question No. 2:

a) Calculate the first three iterations of Gauss-seidel method for the system of equations
$8x - 3y + 2z = 20$, $6x + 3y + 12z = 35$, $4x + 11y - z = 33$

b) Write an algorithm to solve the nonlinear equation using regula falsi method.

Question No. 3:

Construct a difference table and determine the order of the most appropriate polynomial approximation to the given data.

X	0.3	0.4	0.5	0.6
Y	12	13	14	16

i) Approximate $f(0.45)$ using newton forward interpolation formula.

ii) Approximate $f(0.56)$ using newton backward interpolation formula.

Question No. 4:

a) Evaluate $\int_{0.1}^{0.5} sin\theta d\theta$ using Simpson's 1/3 formula by taking $N = 6$ and compare it with the exact value.

b) Write the algorithm for Trapezoidal Rule of integration.

Question No. 5:

Find $f'(4.5)$ and $f''(4.5)$ from the data

X	0.2	0.3	0.4	0.5
Y	12	14	16	18

Question No. 6:

Use method RK method of order 4 with $h = 0.5$, $N = 4$, to obtain approximations to the solution of the initial-value problem
$y' = y - t^2 + 1$, $0 \le t \le 2$, $y(0) = 0.5$

Question No. 7:

Define eigenvalues, eigenvectors and spectral radius of a matrix A. Compute

i) Eigenvalues and associated eigenvectors, ii) Spectral radius of the matrix $\begin{bmatrix} 0 & \frac{1}{2} \\ \frac{1}{2} & 0 \end{bmatrix}$

UNIVERSITY OF THE PUNJAB

B.S. in Computer Science Third Year : Annual – 2021

Subject: Islamic Studies I & II & Pakistan Studies Paper: 17

Roll No. .....

Time: 3 Hrs. Marks: 100

USE SEPARATE ANSWER BOOK FOR EACH PART

Part-I (Islamic Studies I & II)

Max. Marks: 60

Note: *Attempt ay THREE questions. While Question No. 1 is Compulsory. All questions carry equal marks.*

نوٹ: کوئی سے تین سوال حل کریں۔ پہلا سوال لازمی ہے۔ ہر سوال کے نمبر مساوی ہیں۔

Q. 1. Answer Briefly.

1) Write the religions before the birth of the Prophet (PBUH) in Makka.

2) What the reward of all deeds depends upon?

3) What is meant by MUWAKHAT-E-MADINA ?

4) What is "MEHR" for Marriage in islam?

5) What is IHRAAM ?

6) Write five basic pillars of Islam.

7) How long was the Caliphate of HAZRAT UMAR BIN KHATTAB (R.A)?

8) When Imam Abu Hanifa died?

9) Who did prepare MUSHAF-E-SIDDIQI?

10) What is meant by SADAQAAT?

(20)

سوال نمبر1: مختصر جواب تحریر کریں:

1۔ حضور ﷺ کی ولادت سے پہلے مکہ میں کون کون سے مذاہب تھے؟

2۔ اعمال کا دارومدار کس بات پر ہے؟

3۔ مواخاتِ مدینہ سے کیا مراد ہے؟

4۔ اسلام میں نکاح کے لیے مہر کسے کہتے ہیں؟

5۔ احرام کسے کہتے ہیں؟

6۔ اسلام کے پانچ بنیادی ارکان لکھیں۔

7۔ حضرت عمر بن خطاب رضی اللہ عنہ کا زمانہ خلافت کتنا تھا؟

8۔ امام ابو حنیفہؒ کی وفات کب ہوئی؟

9۔ مصحفِ صدیقی کس نے تیار کروایا؟

10۔ صدقات کی اصطلاح سے کیا مراد ہے؟

Q. 2. How the Holy Quran was preserved by third Caliph Hazrat Usman (RA)?

سوال نمبر2۔ عہدِ عثمانی میں قرآن مجید کی حفاظت کے لیے کیا اقدامات کیے گئے؟

Q. 3. How the Ahadith were preserved during the life of The Prophet (PBUH)?

سوال نمبر3۔ عہدِ نبوی ﷺ میں احادیث نبویہ کو کس کس طرح محفوظ کیا گیا؟

Q. 4. What is the basic concept of Life in Islam? Discuss in detail.

سوال نمبر4۔ اسلام کا نظریہ زندگی تفصیل سے بیان کریں۔

Q. 5. Write the Importance & impact of 'SAUM' (Fasting) in Islam.

سوال نمبر5۔ اسلام میں روزے کی اہمیت واثرات پر تفصیلی نوٹ لکھیں۔

P.T.O.

Part-II (Pakistan Studies)

Max. Marks:40

Note: Attempt any TWO questions. All Questions carry Euaql Marks.

Q.1. Discuss the Pakistan Ideology in the light of the statements of the Quaid-e-Azam Muhammad Ali Jinnah. (20)

سوال نمبر ۱: قائداعظم محمد علی جناح کے فرمودات کی روشنی میں نظریہ پاکستان کی وضاحت کریں۔

Q.2. Discuss the aims and objectives of the creation of Pakistan? (20)

سوال نمبر ۲: قیامِ پاکستان کے اغراض و مقاصد بیان کریں۔

Q.3. Write a critical note on the Anti-Muslim Policies of Congress Ministries in 1937-1939? (20)

سوال نمبر ۳: کانگریسی وزارتوں (1937-1939) کی مسلمانوں کے خلاف پالیسیوں پر بحث کریں۔

Q.4. Discuss the strategic importance of Pakistan's location in the world. (20)

سوال نمبر ۴: دنیا میں پاکستان کی جغرافیائی اہمیت پر بحث کریں۔